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ARMY ENGINEER DISTRICT ST LOUIS MO
NATIONAL DAM SAFETY PROGRAM, INDIAN ROCK LAKE DAM (MO 31033), M--ETCIU
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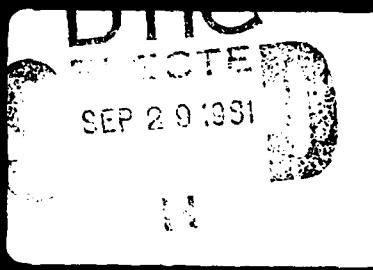
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

INDIAN ROCK LAKE
FRANKLIN COUNTY, MISSOURI
MISSOURI INVENTORY NUMBER 31033

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI
JULY 1978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

NAME: Indian Rock Lake
LOCATION: Franklin County, Missouri
STREAM: Tyrey Creek

Indian Rock Lake Dam (No. 31033) was inspected using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U. S. Army, Washington, D.C., with the help of Federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

The inspection was unscheduled and accomplished at the request of the Franklin County Planning Commission and information received from the Missouri Department of Natural Resources. Both sources indicated concern for the dam's safety.

The inspection team concluded that THE DAM IS UNSAFE.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life or appreciable property loss could occur in the event of failure of the dam. A subdivided recreational development with several dozen numbered lots is located adjacent to the creek within a mile below the dam. These lots are apparently in frequent use for camping. Several downstream residences would also be subject to possible damage. The dam is in the intermediate size classification since it is more than 40 feet high.

A major earth slide was present on the downstream face. The slide was still active at the time of the inspection. Excessive seepage was occurring through and beneath the dam and its abutments. An unprotected 6 foot x 6 foot notch had recently been cut through the earth embankment as an emergency spillway. Heavy rains and/or additional slide movement could cause breaching of the dam in the slide area and subsequent failure.

The spillway in the right abutment is inadequate to pass any flow without overtopping, because the invert of the spillway is higher than the top of the dam. The guidelines recommend dams of this size and hazard classification have spillways capable of passing the Probable Maximum Flood.

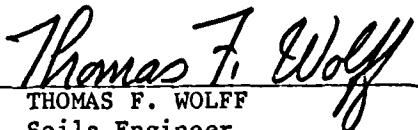
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The emergency spillway, upstream embankment face and downstream exit channel have insufficient or no erosion protection. The downstream exit channel (from the emergency spillway to the creek) was actively eroding at the time of the inspection.

The dam was reported to the Governor's office as unsafe verbally on 12 May 1978 and in writing on 15 May 1978.

As far as could be determined, seepage and stability analyses are not known to be on record as prescribed in the "Recommended Guidelines."

We recommend the lake be drained until the deficiencies listed herein are corrected by the owner. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design of dams. These conclusions were reached by the undersigned inspection team members.



THOMAS F. WOLFF
Soils Engineer



CHIEN HSIEH
Hydraulic Engineer

SUBMITTED BY

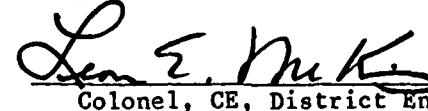


Chief, Engineering Division

30 Aug 78

Date

APPROVED BY:



Colonel, CE, District Engineer

31 Aug 1978

Date



OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
INDIAN ROCK LAKE

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HYDROLOGIC COMPUTATIONS

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
INDIAN ROCK LAKE - I.D. NO. 31033

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority: The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States.

b. Purpose of Inspection: The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria: Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances: The dam is an earthfill dam. There are no appurtenant structures. A spillway cut in the right abutment is nonfunctional since it is higher than the dam crest. A cut had recently been made through the embankment near the left abutment and this cut was serving as an emergency spillway.

b. Location: Section 15, Township 40 North, Range 2 East. Southeast corner of Franklin County.

c. Size Classification: Intermediate.

d. Hazard Classification: High. An area of subdivided lots used for recreational camping is located on the creek bank within a mile. Several residences are also located downstream of the dam.

e. Ownership: Mr. Lester Lange
Rt 1 Box 371
High Ridge, Missouri
(Highway 30)
(Determined from county assessor's Records)

f. Purpose of Dam: Apparently future recreation. No present adjacent development.

g. Design and Construction History: Aerial photography and local contacts indicate the dam was constructed in the last two years. It is uncertain whether dam is actually considered complete. Owner was not available prior to or at time of inspection. No design information is known to exist.

h. Normal Operating Procedures: Not applicable. No facilities available for controlling water levels or outflow.

1.3 PERTINENT DATA

a. Drainage Area: 310 Acres

b. Discharge at Damsite: Unknown.

c. Elevation: (All elevations referenced to assumed datum el. 100.0 at temporary benchmark near left abutment)

Top of dam - 93.4 max.
Top of slide - Approx. 89.6
Spillway invert - 98.7
Streambed - 36.6 (toe of dam)

d. Reservoir:

Length of maximum pool - 2300 + ft.

e. Storage (acre-feet)

Top of dam - Unknown

f. Reservoir Surface (acres)

Top of dam - 25 Acres
Spillway crest - Not applicable - Spillway crest above top of dam

g. Dam:

Type - Earth fill
Length - 700 ft.
Height - 57 ft.
Top width - 25 to 30 ft.
Side Slopes - Downstream, estimated 1V to 1.5H or 2.0H;
Upstream underwater

Zoning - none evident in embankment spillway cut
Impervious core - unknown. Embankment apparently
homogeneous
Cutoff - unknown; apparently none
Grout curtain - unknown

h. Diversion and regulating tunnel: None

i. (1) Spillway: (in right abutment)

Type - cut through abutment
Length of weir - 15 ft. bottom trapezoidal cut
Crest elevation - 98.7 (approximately 5 ft. above top
of dam)
Gates - none

(2) Emergency Spillway: (through embankment near left
abutment)

Type - recent backhoe cut through embankment
Length of weir - 6 ft.
Crest elevation - 85.6
Gates - none

j. Regulating Outlets: None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. The presumed owner could not be reached prior to the inspection. No design drawings or computations are known to exist.

2.2 CONSTRUCTION. Details unknown. Based on topographic maps, vegetation and local contacts, the dam has reportedly been constructed in the past two years. This spring (78) appears to be the first filling. 1976 aerial mapping indicates that the highest part of the embankment, where the slide occurred, was constructed last.

2.3 OPERATION. The 6 ft. wide cut through the embankment was reportedly made about two weeks prior to the inspection when water was near the top of the embankment and had no outlet.

2.4 EVALUATION

a. Availability: None

b. Adequacy: The field surveys and visual inspections presented herein are considered adequate to support the conclusions in this report. No seepage or stability analyses are known to exist as prescribed in the Recommended Guidelines.

c. Validity: Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS.

a. General: The dam inspection was made on 11 May 1978 because of a request by the Franklin County Planning Commission and information received from the Missouri Department of Natural Resources the preceding day and the morning of the inspection. Both sources expressed concern for the dam's safety. Numerous attempts to reach the (presumed) owner prior to and during the inspection and the following weekend were unsuccessful. (Note: The term "presumed owner" is used herein to refer to Mr. R. J. Taylor, whose name was furnished by the Department of Natural Resources as the owner. As shown in Sec. 1.2, the county assessor's records give Mr. Lange as the owner. However, Mr. Taylor is also understood to have an interest in the dam. Because of the expressed concern for safety, the inspection was made without the owner's knowledge. The site was revisited on 12 May for further observation.

b. Project Geology: Field inspection indicated that bedrock at the left abutment is red sandstone of the Ordovician Roubidoux formation. Along the creek below the dam, outcrops are white dolomite, apparently of the Ordovician Gasconade formation. The state geologic map indicates an extension of the Ste. Genevieve fault system passes through or near the reservoir site. Cambrian rocks of the Eminence-Potosi formations are shown on the upstream side of the fault to the south of the lake.

c. Dam: The dam is an earth embankment comprised of red, sandy, gravelly clay. A massive circular-arc slide was present on the downstream face. (See photo 4 and 5) The slide was 160 feet wide and extended almost to the toe. Slide material had been deposited at the toe. Material in the lower portion of slide was gray silty clay with an organic odor. This material was in a "quick" condition and apparently had flowed during early slide movement. The slide encompassed the crown of the dam, with the scarp cutting the poolside crown. Tension cracks were evident behind the scarp. The revisit on 12 May disclosed additional movement during the preceding night. Occasionally, chunks of soil would be seen to slide off from the top of the slide. These features indicated the slide was still active.

Slopes of the dam were fresh earth with only a light covering of brush. Erosion gullies (about 1 foot deep) were present in many locations.

Due to rainy conditions, separation of runoff from seepage was somewhat subjective. However, the extent of standing water above, at, and below the dam toe made it evident that considerable seepage,

both through and under the dam and its abutments, was occurring. An area along the creek 100 feet downstream was quick (unable to support one's foot) due to upward seepage through the soil. The presence of cattails at the dam toe suggest that seepage has been occurring for an extended time.

An unprotected 6-foot by 6-foot outlet cut through the embankment as an emergency spillway indicated the dam is unzoned, or of homogeneous construction in the area exposed. Numerous roots were found in the fill material (see photo 2). These roots constitute a potential seepage hazard as they decay. Sidewalls of the cut were firm but the bottom was soft from flowing water. No erosion protection was provided. This earth cut could not be expected to remain intact during any prolonged flow. Significant embankment erosion, and possible failure, would likely occur.

The top of the slide was about 4 feet above the water. Should heavy rain and/or additional slide movement occur, the lake could begin overflowing through the slide area. Subjecting the already-loose slide material to such flow could result in rapid erosion, and partial to complete breaching of the dam.

d. Appurtenant Structures: The dam has no appurtenant structures.

e. Reservoir Areas: No pertinent problems were noted except access. Wet, steep, and narrow dirt roads made access extremely difficult, and would adversely affect timely accomplishment of remedial actions.

f. Downstream Channel: No channel was provided from the emergency cut spillway to the creek. Flowing water was cutting its own channel, which increased in size significantly from 11 May to 12 May. Continuing uncontrolled flow could erode the dam toe.

3.2 EVALUATION. THE DAM IS UNSAFE. The existence of a massive active slide, insufficient spillway size, absence of erosion protection, significant seepage, and steep slopes are serious deficiencies. Because of these deficiencies, the likelihood of rain, and potential for loss of life in the event of a failure, the inspection team reported their findings from the site by radio and recommended the Governor be notified.

SECTION 4 - OPERATION PROCEDURES

4.1 PROCEDURES. Since the dam has no control works, operational procedures are essentially nonexistent. As previously stated, an emergency spillway was recently cut through the dam embankment.

4.2 MAINTENANCE OF DAM. Little maintenance is apparent. The embankment has apparently never been seeded.

4.3 MAINTENANCE OF OPERATING FACILITIES. Not applicable.

4.4 WARNING SYSTEM. No warning system exists.

4.5 EVALUATION. After the required major repairs are completed, grass cover should be established and maintained on the embankment.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data is not available.

b. Experience Data. The drainage area and lake surface area were obtained from the USGS Richwoods Quadrangle and 1 inch = 400 feet topographic map by Surdex Corp. The alignment of the dam and spillways were developed from surveys made during the inspection.

c. Visual Observations.

(1) Drawdown facilities necessary to evacuate the pool are not provided for the lake.

(2) The spillway cut in the right abutment is a 15 feet flat bottom channel which extends over the ridge and spills into the adjacent stream. (See photo 8).

The invert of the spillway is approximately 5 feet above the top of the dam.

Runnels due to side inflows were noted at the side slopes of the spillway channel.

(3) An unprotected 6 feet by 6 feet notch had recently been cut through the embankment near the left abutment to serve as an emergency spillway. The water flowing through the notch was cutting its own exit channel parallel to the toe of the dam to the creek. (See photos 2 and 3).

Approximately 5 cfs was flowing through the notch at the time of the inspection and that flow was eroding the exit channel. Any significant and sustained flows through the emergency spillway could cause excessive erosion of the embankment and the exit channel. The excessive erosions could threaten the safety of the dam.

d. Overtopping Potential. As per the original design of the lake (not considering the emergency spillway) the spillway in the right abutment cannot pass any flow without overtopping the dam. The recently cut emergency spillway at the left end of embankment and its exit channel can neither pass the probable maximum flood without overtopping the dam nor withstand any significant and sustained flows without endangering the integrity of the dam. The spillways are considered highly inadequate from a hydraulic and hydrologic view point.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY.

a. Visual Observations: Visual observations of the dam are discussed and evaluated in Section 3. As previously discussed, a major slide has occurred on the downstream face.

b. Design and Construction Data: As discussed in Section 2, no data is available. Stability and seepage analyses are not known to be on record.

c. Operating Records: Not available.

d. Post-Construction Changes: A 6 foot x 6 foot notch was cut through the embankment to function as an emergency spillway. This cut is understood to have been made one or two weeks prior to the inspection.

e. Seismic Stability: The Indian Rock dam is located in seismic zone 2, for which the recommended guidelines for inspection assign a "moderate" damage probability. As discussed in Section 3, a fault crosses through or near the damsite; this fault is considered inactive. Although earth dams of this height are usually able to resist moderate shocks, the condition of the active slide and seepage is such that a minor shock from any source could accelerate caving of material in the slide and initiate embankment failure.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety: THE DAM IS UNSAFE. The slide on the downstream slope extended through the crown and into the upstream face. The lake level was approximately 4 to 5 feet lower than the top of the slide. Comparative observations on 11 and 12 May and observed caving of material indicated the slide was still active. Additional slide movement and/or a rise in the pool could result in breaching of the embankment, rapid erosion of the loose slide material, and failure of the dam.

The scattered rock on the upstream face is insufficient to protect the dam from erosion by waves. The emergency spillway cut through the embankment had no erosion protection and could not be expected to remain stable through any sustained flow. The spillway cut in the right abutment is higher than the dam crest and is therefore non-functional. The dam has insufficient spillway capacity to pass any significant flow and overtopping would result. Considerable seepage is flowing through and under the dam and the abutments and continued stability under these conditions cannot be assured.

Flow from the emergency spillway recently cut in the embankment is eroding an exit channel downstream of the dam toe. Continued flow could cause this channel to encroach on the embankment toe.

b. Adequacy of Information: The statements and recommendations in this report are based on visual observations. Seepage and stability analyses are not known to be on record as prescribed in the recommended guidelines. The visual observations are considered adequate to conclude the dam is unsafe.

c. Urgency: Because of the condition of the dam, likelihood of rain, and proximity of the camping lots and homes downstream, the inspection team reported its findings by radio from the site on 11 May (p.m.) and the Governor's office was notified on 12 May (a.m.). We recommend the lake be drained and breached until remedial actions listed in Section 7.2 are accomplished.

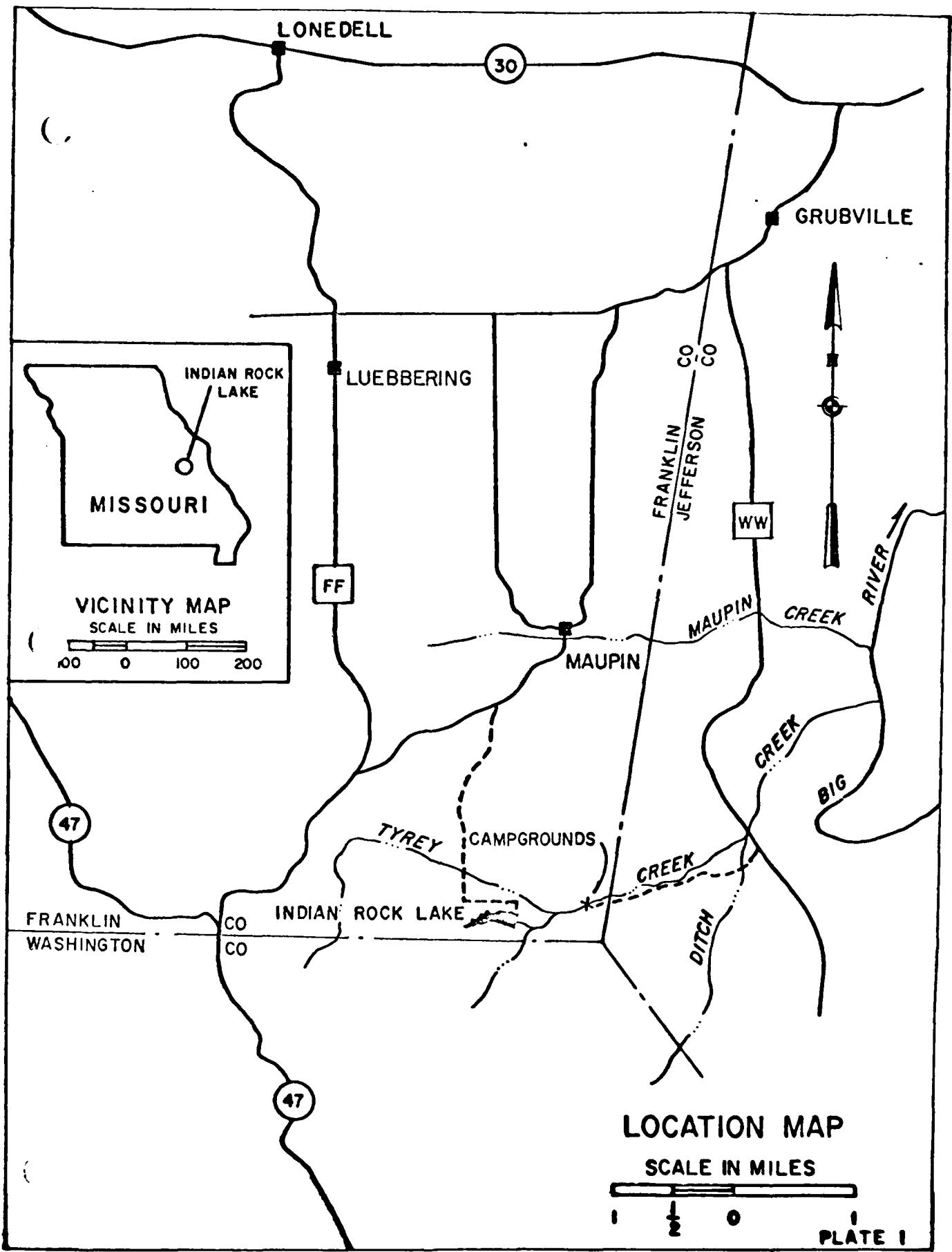
d. Necessity for Phase II: No Phase II inspection is recommended. The lake should be drained until the recommended remedial measures are accomplished.

7.2 REMEDIAL MEASURES.

The following remedial measures are recommended:

a. Drain the lake under the supervision of a qualified engineer.

- b. Remove and stockpile or waste all material in the slide area.
- c. Engage a registered professional engineer experienced in the design and construction of dams (if dam is to be reconstructed) to redesign the dam and supervise construction. The dam should be redesigned for safety based on stability and seepage analyses.
- d. Provide an adequately sized and erosion resistant spillway and exit channel with proper energy dissipators.
- e. Provide wave protection on the upstream face of the embankment.
- f. A detailed inspection of the dam and spillway should be made every two to five years by a professional engineer experienced in the design and construction of dams.
- g. The residents of permanent homes and owners of camping lots downstream should be advised of the flooding potential from overtopping or failure of Indian Rock Dam.





SCALE IN FEET

A scale bar oriented vertically, labeled "SCALE IN FEET". It has tick marks at 0, 2000, and 4000.

JEFFERSON COUNTY

INDIAN ROCK LAKE
VICINITY TOPOGRAPHY

PLATE 2

FRANKLIN COUNTY

WASHINGTON COUNTY

DRAINAGE AREA

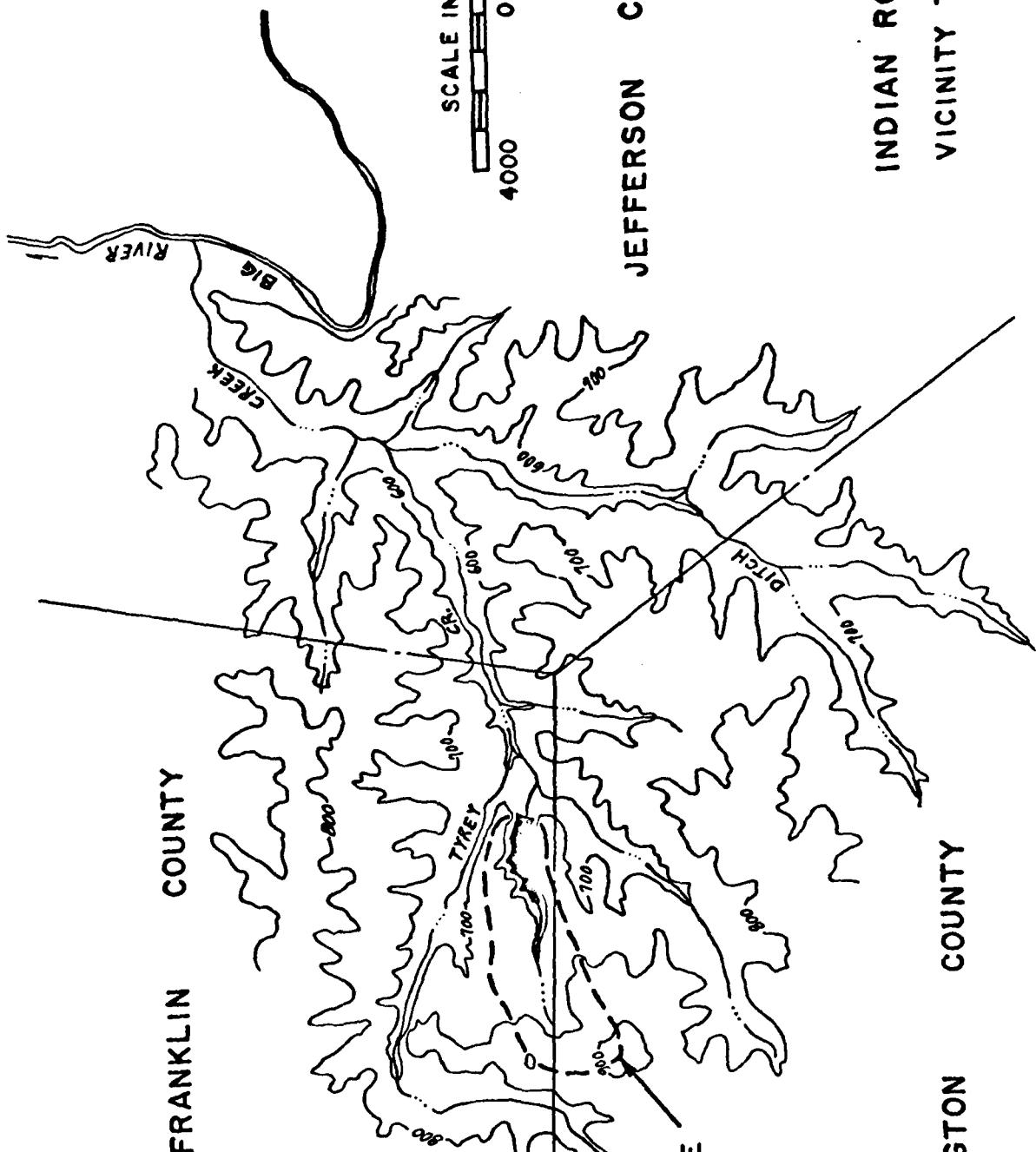
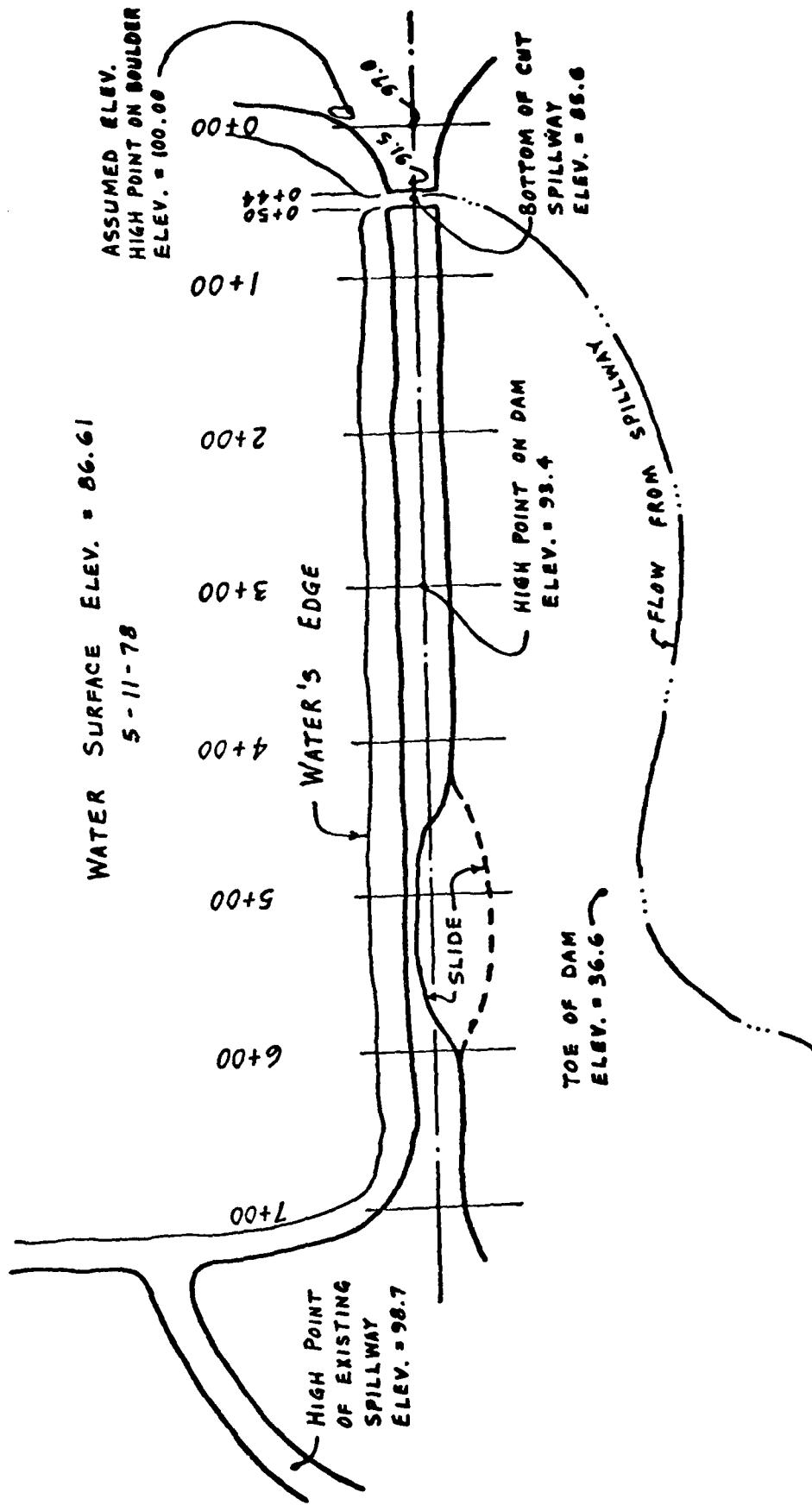


PLATE 3

INDIAN ROCK DAM
PLAN

SCALE: 1" = 100'



HYDROLOGIC COMPUTATIONS

Detailed hydrologic and hydraulic analyses of the dam were not performed, because the invert of spillway is higher than the top of the dam, and the emergency spillway was cut for emergency drawdown of the lake and not designed to use as permanent spillway.



PHOTO 1 Embankment Crown

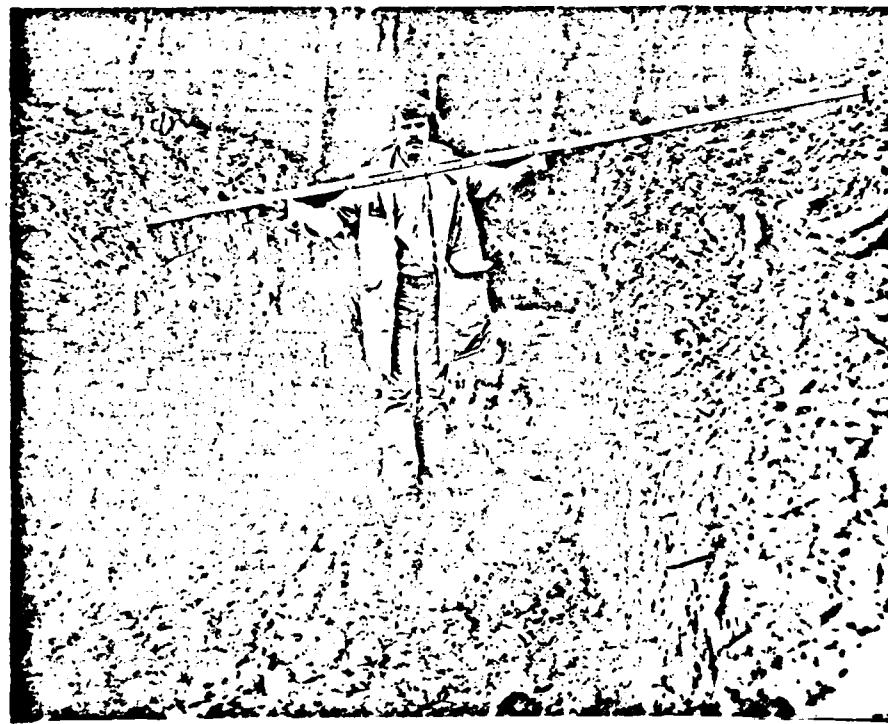


PHOTO 2 Spillway cut through embankment



PHOTO 3 Spillway discharge



PHOTO 4 Slide on downstream slope



PHOTO 5 Slide on downstream slope

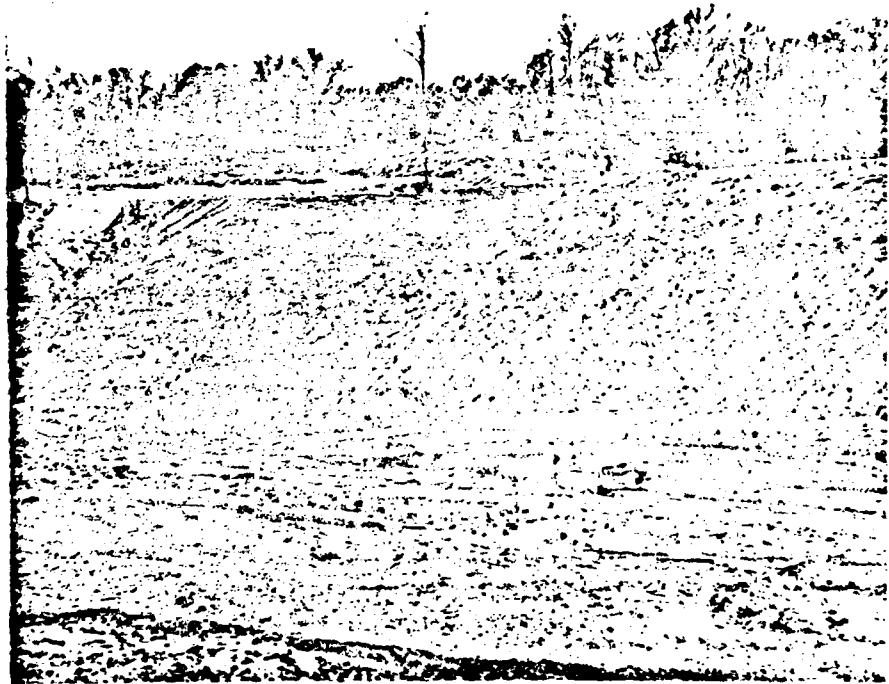


PHOTO 6 Downstream slope of dam



PHOTO 7

Downstream toe area



PHOTO 8

Nonfunctional auxiliary spillway



PHOTO 9

Dam viewed from auxiliary spillway